Study Indicates Unexpected Earthquake Dangers Lie Beneath the Pacific Northwest

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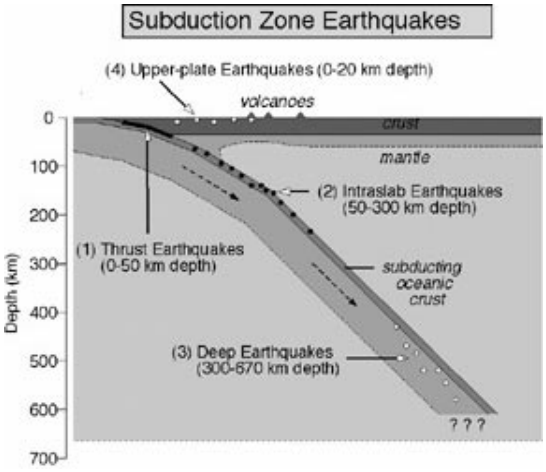
When it comes to damaging earthquakes in the **Pacific Northwest,** everyone worries about ***"The Big One,"*** a great thrust earthquake caused by the rupture of a huge offshore fault beneath the ocean, but there are other kinds of earthquake that may be just as dangerous.

In fact, the most damaging earthquake in the U.S. Pacific Northwest in this century was a different type of shock called an ***"intraslab earthquake."*** That magnitude 7.1 event occurred **in 1949 beneath Olympia, Washington** and caused over $100 million in damage.

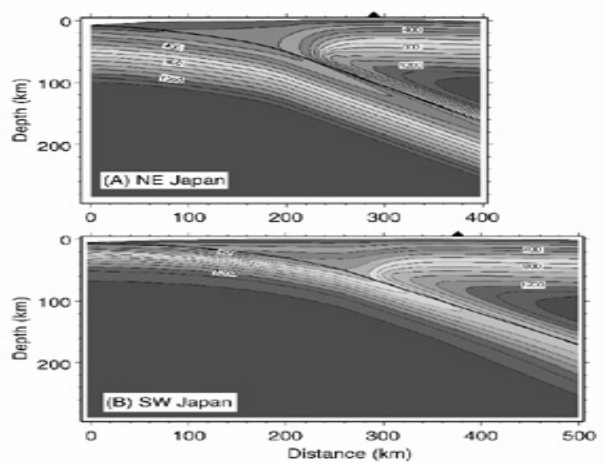
A new study by Arizona State University geologist Simon M. Peacock and Kelin Wang, a geoscientist at the Geological Survey of Canada's Pacific Geoscience Centre, provides firm support for a recent theory that explains how **intraslab** earthquakes work and confirms the hazard posed to certain geographic areas.

Both great thrust earthquakes and **intraslab** earthquakes occur in ***"subduction zones,"*** where oceanic crust dives beneath the edge of a continent. Great thrust earthquakes occur at shallow depths of 0 to 50 kilometers along the sloping boundary between the descending plate and the continental margin. In contrast, **intraslab earthquakes** occur within the descending oceanic crust at depths of 50 to 300 kilometers beneath the surface and are caused by different processes.



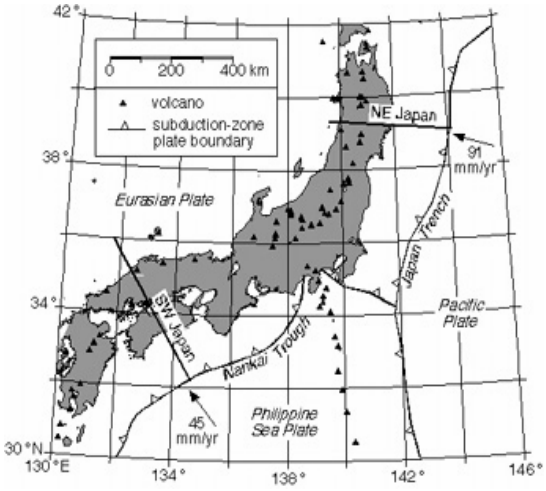
"The risks posed by intraslab earthquakes have not been fully incorporated into seismic hazard analysis," said Peacock. *"In many cases, such as the **Pacific Northwest**, these less easily understood earthquakes occur closer to major population centers than the larger offshore earthquakes. The historic record bears this out."*

In 1996, Stephen H. Kirby and colleagues at the U.S. Geological Survey proposed a mechanism for **intraslab earthquakes** which is supported by the current study. Basically, Kirby's theory proposes **intraslab earthquakes** occur because the intense heat and pressure in subduction zones metamorphose (or change) the descending oceanic crust into denser rocks. These mineralogical changes cause the subducting oceanic crust to liberate water stored in the original minerals and to reactivate pre-existing faults.



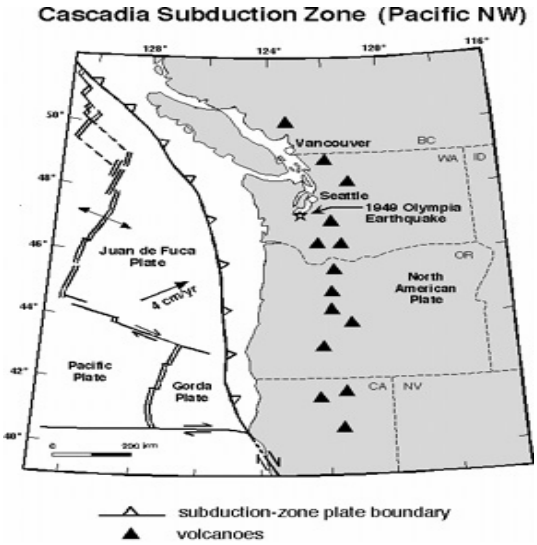
"In the absence of water, these faults would not move because of the weight of the overlying rocks," said Peacock. *"The liberated water essentially lubricates the fault - pumping up the water pressure causes the fault to slip."*

Peacock and Wang tested Kirby's theory by comparing two subduction zones in Japan, carefully calculating the temperature of the subducting oceanic crust, and comparing their seismic and volcanic records. Confirming Kirby's theory, the results showed that the oceanic crust subducting beneath southwest Japan - a *"warm"* subduction zone – should liberate water at shallower depths and thus trigger only shallow **intraslab earthquakes** and less volcanic activity as compared to activity in the cold subduction zone beneath northeast Japan.



"Things happen much deeper beneath northeast Japan because the subducting crust is much colder and water is released at much greater depth" said Peacock. *"It's the water being released at depth that generates these **intraslab earthquakes** and subduction-zone volcanoes. **Intraslab earthquakes** occur at relatively shallow depths beneath southwest Japan because the subducting oceanic crust is warmer."*

Like southwest Japan, the Pacific Northwest (northern California, Oregon, Washington, and southern British Columbia) and southern Mexico are underlain by warm subduction zones.



*"The **Vancouver-Seattle-Tacoma** area may be more at risk from an intraslab earthquake than from a larger earthquake along the offshore trench,"* Peacock said. *"This risk has only recently been recognized. We're starting to realize that we have to worry about a **magnitude** 7 to 7.5 **intraslab earthquake** located **50 km beneath Seattle or Vancouver**, as well as a magnitude 8 or 9 out on the coast."*

*"Large **intraslab earthquakes** occur quite frequently. On September 30, 1999 a magnitude 7.4 **intraslab earthquake** shook Oaxaca, Mexico killing at least 27 people."*

Peacock, whose main field of expertise is metamorphic petrology, points out that this study is an example of how specialized scientific research can sometimes yield information with real significance to everyday life. *"For years I have studied metamorphism, a largely academic subject. Now we've learned that there is a solid connection between metamorphic processes and earthquakes that have killed tens of thousands of people,"* he said.